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Surface exposure dating of moraines and alluvial fans in the Southern Central Andes

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The role of tectonics versus climate in controlling the evolution of alluvial fans in discussed controversially. The southern Central Andes and their forelands provide a perfect setting to study climate versus tectonic control of alluvial fans. On the one hand, the region is tectonically active and alluvial fan surfaces are offset by faults. The higher summits, on the other hand, are glaciated today, and glacial deposits document past periods of lower temperatures and increased precipitation.
We applied 10Be surface exposure dating on 5 fan terraces 4 moraines of the Ansilta range (31.6°S - 69.8°W) using boulders and amalgamated pebbles to explore their chronological relationship. From youngest to oldest, the alluvial fan terraces yield minimum ages of 15 $\pm$ 1 ka (T1), 97 $\pm$ 9 ka (T2), 141 $\pm$ 9 ka (T3), 286 $\pm$ 14 ka (T4) and 570 $\pm$ 57 ka (T5). Minimum ages derived from moraines are 14 $\pm$ 1 ka (M1), 22 $\pm$ 2 ka (M2), 157 $\pm$ 14 ka (M3) and 351 $\pm$ 33 ka (M4), all calculations assuming no erosion and using the scaling scheme for spallation based on Lal 1991, Stone 2000. The moraines document glacial advances during cold periods at the marine isotope stages (MIS) 2, 6 and 10. The terraces T1, T3 seem to be geomorphologic counterparts during MIS 2 and 6. We suggest that T2, T4 and T5 document aggradation during the cold periods MIS 5d, 8 and 14 in response to glacial advances, although the respective moraines are not preserved.
Our results highlight: i) the arid climate in the Southern Central Andes favors the preservation of glacial and alluvial deposits allowing landscape and climate reconstructions back to ~570 ka), ii) alluvial deposits correlate with moraines or fall into cold glacial times, so that climate, and in particular the existence of glaciers, seems to be the main forcing of alluvial fan formation at our study site.

References

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